radical surgical procedures to be done in locally aggressive and malignant bone tumors as well as heal traumatic defects in long bones more predictably.

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REFERENCES

Weiland AJ, Daniel RK: Free vascularized bone grafts. Orthop Review 7:119-120, May 1978

O'Brien B: Microvascular Reconstructive Surgery. Edinburgh, Churchill Livingstone, 1977, pp 267-283

The Use of Transcutaneous Doppler Ultrasound in Predicting Healing Potential and Selection of Surgical Levels in Dysvascular Lower Limbs

TRANSCUTANEOUS DOPPLER ULTRASOUND has been used at Rancho Los Amigos Hospital to determine healing and surgical levels in dysvascular lower limbs. The Doppler probe is used as a sensitive stethoscope to map the arterial tree and to determine systolic blood pressures. Carter pointed out that healing of skin lesions was poor in diabetic and nondiabetic patients if the systolic pressure was less than 55 mm of mercury. The prognosis was good if pressures were above 70 mm of mercury. We have extended this use of Doppler pressures by comparing the lower extremity pressure with that of the upper extremity. The Doppler technique is of particular value as it allows blood pressures to be taken that cannot be heard with the standard stethoscope in the dysvascular lower limb.

Systolic pressure is measured in the brachial artery, at the upper, middle and lower thigh, at the upper and middle leg, at the ankle and midfoot and in the toes. Frequencies between 9 and 10 MHz appear to be more satisfactory for the smaller vessels in the toe and midfoot. The width of the sphygmomanometer cuff should be 120 percent of the width of the extremity at the site being measured.

An ischemic index is calculated by dividing the lower extremity pressure by the brachial artery pressure. The brachial artery is considered normal for that patient's particular physiological processes and the index is thus usually 1 or a fraction thereof. For example, if the pressure is 120 in the arm and 60 at the knee, the ischemic index at that level would be 60/120 or 0.5. For a pressure of 30 at the midfoot, the index would be 30/120 or 0.25. The healing level is predicted in diabetic persons where the index is at least 0.45 and in nondiabetic persons where the index is at least 0.35. In addition, the systolic pressure should be at least 70 mm of mercury and the flow should be pulsatile.

The usual case seen is that of a 55-year-old diabetic patient with an open ulcer on the foot that has not responded to local treatment. Nonoperative procedures such as intravenous administration of antibiotics, local treatment with organic iodine complexes and Collen triple iodide solution, walking casts and similar treatments are begun. Lesions that do not heal are then treated surgically.

In all, 377 consecutive lower extremity surgical procedures were carried out from January 1975 to May 1978. There were 314 diabetic and 63 nondiabetic patients. Surgical procedures included incision and drainage of superficial to deep abscesses, toe and partial foot amputations, and major amputations including Syme, below knee, through knee and above knee. There was healing in 92 percent of the diabetic and 97 percent of the nondiabetic patients for an overall healing rate of 93 percent. This contrasts notably with the approximately 70 percent healing rate which was obtained previously with clinical indicators such as temperature, leukocyte count, arteriography, and similar standard clinical evaluations for lesions in dysvascular lower limbs.

A transcutaneous Doppler ultrasound study is a noninvasive test and can be carried out as an outpatient test with relatively inexpensive portable equipment. The procedure should be added to the diagnostic armamentarium wherever amputations are done and lesions of the dysvascular lower limb cared for.

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REFERENCES

Carter SA: The relationship of distal systolic pressures to healing of skin lesions in limbs with arterial occlusive disease, with special reference to diabetes mellitus. Scand J Clin Lab Invest 31:Suppl 128:239, 1973

Wagner FW Jr: Amputations of the foot and ankle: Current status. Clin Orthop, Jan-Feb 1973, pp 62-69

Autologous Transfusions: Their Use in Spinal Surgery

AUTOLOGOUS TRANSFUSION is a safe and effective way of providing a patient with perfectly crossmatched blood that has minimal risk of disease transmission. Autologous transfusions have received increasing attention in recent years. We established a program of preoperative blood collection and storage for patients undergoing Harrington rod instrumentation for treatment of scoliosis. A study was done with 40 patients and

the results for 20 patients who participated in the autologous transfusion program were compared with those for 20 control patients. An average of five units of autologous blood was collected before operation from the participants. The average length of time from the first visit to the blood bank for phlebotomy to surgical operation was 8½ weeks. No patient came to surgery with an hematocrit of less than 30 percent. Complications associated with collection were minor and were related to transitory hypotension.

Of the 20 participants, 7 required no homologous blood and 13 required additional homologous blood. There were no complications associated with the transfusion of autologous blood. However, there was one patient who participated in the autologous blood transfusion program who did have a weak isoleucoagglutinin transfusion reaction upon receipt of a unit of homologous blood. Transfusion reactions developed in two patients in the control group; in one a weak cold agglutinin developed and in the other a weak isoleucoagglutinin reaction occurred.

The patients who participated in the program were predominantly young females undergoing extensive surgical procedures and requiring massive transfusions. The use of autologous blood reduced the risk of disease transmission, avoided hemolytic transfusion reaction as well as minor transfusion reactions, and reduced the risk of isoantibody sensitization, which might complicate future pregnancies. The use of autologous blood for transfusion reduces perioperative and postoperative morbidity and its wider application for elective orthopaedic procedures is recommended.

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REFERENCES

Cowell HR, Swickard JW: Autotransfusion in children's orthopaedics. J Bone Joint Surg(Am)56:908-912, Jul 1974

Mallory TH, Kennedy M: The use of banked autologous blood in total hip replacement surgery. Clin Orthop, Jun 1976, pp 254-257

Musculoskeletal Soft Tissue Masses

AN EXTREMITY MASS that is suddenly noted by a patient can be a perplexing and possibly serious problem. A few special studies may be helpful, but most of the important information can be obtained by a simple history, physical examination, x-ray films and basic laboratory studies. It is reassuring that most of all such suddenly appearing lumps are benign but since the individual odds are either zero or 100 percent (it is either a cancer or not) it is good practice to consider all of them malignant until proven otherwise.

Distinguishing a solid (probably neoplastic) mass from a fluid mass is most easily done by transillumination. Optimally, there must be time for dark adaptation and a shielded light source in a completely darkened room. If the mass does not brightly transilluminate, it is probably a solid tumor and a biopsy specimen must be taken without delay. The only solid tumors that transilluminate are lipomas and, occasionally, low-grade liposarcoma. Hematomas, although fluid, will not transilluminate. If the mass transilluminates, it should be aspirated for confirmation and specific studies, occasionally including the injection of water-soluable contrast material for a "cavitygram." If the mass is attached to the skin, particularly by a scar, it suggests an epidermal inclusion cyst. If the mass moves transversely but not in the long axis of the extremity, it suggests a tumor of a peripheral nerve. The consistency of a given mass is not of diagnostic importance and the old aphorism that "cancer is hard" is not reliable. Rapidly growing tumors tend to be soft because of hemorrhage or necrosis. Hemangiomas feel warm to the touch and may diminish in size on elevation of the extremity. Ganglia and cysts communicating with a joint may change in size with motion. If the tumor is in a muscled region, subfascial tumors are *less* palpable and subcutaneous tumors are *more* palpable when the muscle is tensed. Muscle hernias are more prominent on contraction and a fascial defect may be palpable on relaxation.

Biplanar x-ray studies can be supplemented with tangential soft tissue technique films using lead skin markers to delineate very simply the density and extent of the tumor. Specific densities may suggest the diagnosis; heavy flocculant calcification occurs in cartilage matrix and multiple spherical densities are often seen in hemangiomas. A lacy or trabecular pattern can be seen in heterotopic bone formation (myositis ossificans), and dusty calcification may be seen in synovial sarcoma. Low grade liposarcomas occasionally present with a rim of calcification at a portion of their periphery. Angiography helps delineate the extent of the mass, may differentiate infection from a vascular malignant tumor, and shows major vessels to the surgeon or radiologist for surgical planning, consideration of chemotherapy infusion, or embolization. Computerized axial